



Worksheet 3 Karnaugh maps

Task 1

1. Fill in Karnaugh maps for the following expressions, showing the groupings by ringing them.

In parts (d), (e) and (f), fill in the missing row and column labels.

(a) A

(b) $\neg A \wedge C$

BC^A

	00	01	11	10
0				
1				

	00	01	11	10
0				
1				

(c) $A \wedge \neg B$

(d) B

(e) $A \wedge B \wedge \neg C$

BC^A

0				
1				

0				
1				

2. Fill in Karnaugh maps for the following expressions, showing the groupings. Hence simplify the expressions.

(a) $(A \wedge B) \vee (A \wedge \neg C) \vee (A \wedge \neg B)$

(b) $(A \wedge B \wedge C) \vee (\neg A \wedge B) \vee (A \wedge B \wedge \neg C)$

BC^A

	00	01	11	10
0				
1				

	00	01	11	10
0				
1				

3. Use a Karnaugh map to show that $A \vee \neg A \wedge B = A \vee B$.

(You drew a truth table to prove this in Worksheet 2, Question 4)

B^A

	0	1
0		
1		

Worksheet 3 Karnaugh maps

Unit 8 Boolean algebra



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Task 2

4. What Boolean expressions do each of the ringed squares in the Karnaugh map in Figure 1 represent?

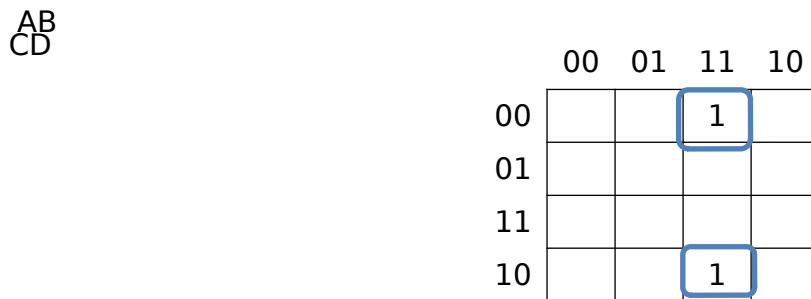


Figure 1

Row 1 column 3 =

Row 4 column 3 =

Write the Boolean expression represented by the map in its simplest form.

5. (a) Ring the two groups in Figure 2. What Boolean expression does this Karnaugh map represent?

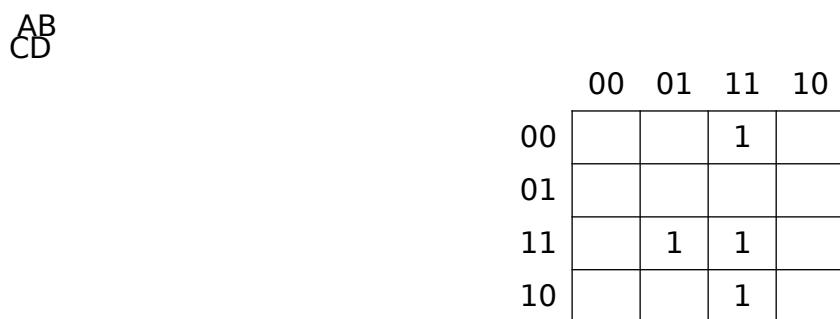


Figure 2

Worksheet 3 Karnaugh maps

Unit 8 Boolean algebra



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(b) Complete the Karnaugh map in Figure 3 to represent the expression:

$$(A \wedge B \wedge C \wedge \neg D) \vee (\neg A \wedge C \wedge \neg D) \vee (A \wedge \neg B \wedge C \wedge \neg D)$$

Draw the resulting group(s) and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 3

(c) Complete the Karnaugh map in Figure 4 to represent the expression:

$$(A \wedge B \wedge C) \vee (C \wedge D) \vee (A \wedge \neg C) \vee (A \wedge \neg B \wedge C \wedge \neg D)$$

Draw the groups, and hence simplify the expression.

AB
CD

	00	01	11	10
00				
01				
11				
10				

Figure 4

Worksheet 3 Karnaugh maps

Unit 8 Boolean algebra



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(d) Complete the Karnaugh map in Figure 5 to represent the expression:

$$(\neg A \wedge \neg B \wedge \neg C \wedge \neg D) \vee (\neg A \wedge \neg B \wedge C \wedge \neg D) \vee (A \wedge \neg B \wedge \neg C \wedge \neg D) \\ \vee (A \wedge \neg B \wedge C \wedge \neg D)$$

Draw the group(s), and hence simplify the expression.

AB		CD			
		00	01	11	10
00					
01					
11					
10					

Figure 5

(e) Complete the Karnaugh map in Figure 6 to represent the expression:

$$(\neg A \wedge \neg B \wedge \neg C \wedge \neg D) \vee (\neg A \wedge \neg B \wedge C \wedge \neg D) \vee (A \wedge \neg B \wedge \neg C \wedge \neg D) \\ \vee (A \wedge \neg B \wedge C \wedge \neg D) \vee (\neg B \wedge D)$$

Draw the group(s), and hence simplify the expression.

AB		CD			
		00	01	11	10
00					
01					
11					
10					

Figure 6

7. How many squares in a Karnaugh map with 4 variables contain 1 when an expression containing only AND symbols has:

- 4 variables, e.g. $(\neg A \wedge \neg B \wedge \neg C \wedge \neg D)$?
- 3 variables e.g. $(A \wedge B \wedge C)$?
- 2 variables, e.g. $(\neg B \wedge D)$?
- 1 variable, e.g. A ?